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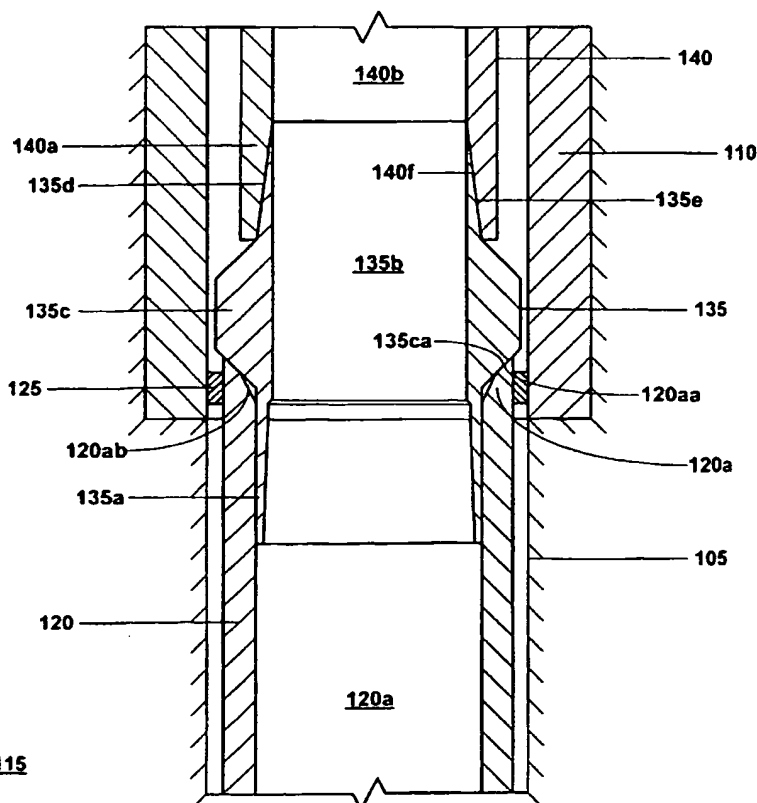
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(54) Title: SEAL RECEPTACLE USING EXPANDABLE LINER HANGER



(57) Abstract: The end of an  
expandable liner hanger (120)  
provides a receptacle for another  
tubular liner (135).

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US02/39425

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(7) : E21B 23/00  
 US CL : 166/207,208,382

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 166/207,208,382,384

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 4,601,343 A (Lindsey, Jr. et al.) 22 July 1986 (22.07.1986), Figures 1 and 2.	1,3,5,7 ----- 9
X --- Y	US 4,942,925 A (Themig) 24 July, 1990 (24.07.1990), Figure 3.	1,7,8 ----- 9
X	US 4,856,592 A (Van Bilderbeek et al.) 15 August 1989 (15.08.1989), Figure 4	1,7,8

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"Z" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

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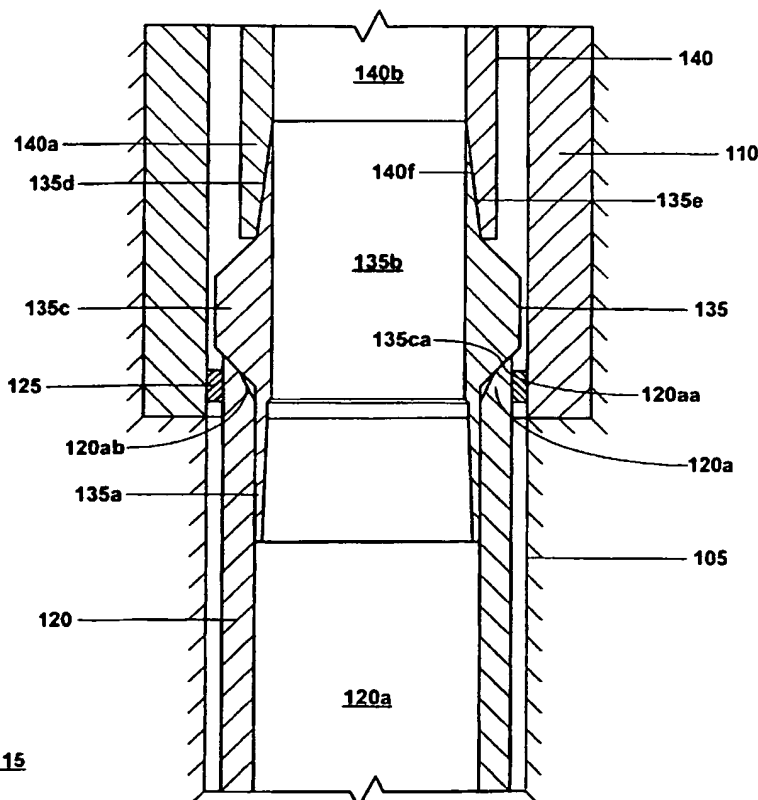
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(54) Title: **SEAL RECEPTACLE USING EXPANDABLE LINER HANGER**



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European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,  
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TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,  
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**AMENDED CLAIMS**

[Received by the International Bureau on 28 July 2004 (28.07.2004) ;  
original claim 1 - 9, replaced by claims 1 - 18]

1. An apparatus, comprising:
  - a subterranean formation defining a wellbore;
  - a tubular wellbore casing positioned within and coupled to the wellbore;
  - a first tubular liner positioned within the wellbore overlapping with and coupled to the wellbore casing;
  - a second tubular liner positioned within the wellbore and overlapping with and coupled to the first tubular liner;
  - wherein the second tubular liner is coupled to the first tubular liner by:
    - machining an end of the first tubular liner; and
    - inserting an end of the second tubular liner into the machined end of the first tubular liner; and
    - wherein the first tubular liner is coupled to the wellbore casing by radially expanding and plastically deforming the first tubular liner into engagement with the wellbore casing.
2. (Canceled)
3. A method for extracting fluidic materials from a subterranean formation including a wellbore that traverses the formation and a wellbore casing positioned within and coupled to the wellbore, comprising:
  - coupling an end of a tubular liner to an end of the wellbore casing;
  - machining an end of the tubular liner;
  - inserting an end of another tubular liner into the machined end of the tubular liner;
  - sealing the interface between the other tubular liner and the wellbore casing; and
  - radially expanding and plastically deforming the tubular liner into engagement with the wellbore casing.
4. (Canceled)
5. A system for extracting fluidic materials from a subterranean formation including a wellbore that traverses the formation and a wellbore casing positioned within and coupled to the wellbore, comprising:
  - means for coupling an end of a tubular liner to an end of the wellbore casing;
  - means for machining an end of the tubular liner;
  - means for inserting an end of another tubular liner into the machined end of the tubular liner;
  - means for sealing the interface between the other tubular liner and the wellbore casing; and
  - means for radially expanding and plastically deforming the tubular liner into engagement with

the wellbore casing.

6. (Canceled)

7. In an apparatus comprising a subterranean formation defining a wellbore that includes a wellbore casing positioned within and coupled to the wellbore and a tubular liner coupled to an end of the wellbore casing, a method of conveying fluidic materials to and from the tubular liner, comprising:

radially expanding and plastically deforming the tubular liner into engagement with the wellbore casing;

machining the end of the tubular liner;

inserting and supporting an end of another tubular liner in the machined end of the tubular liner;

and

conveying fluidic materials to and from the tubular liner using the other tubular liner.

8. The method of claim 7, wherein the other end of the tubular liner extends through the wellbore casing.

9. The method of claim 8, further comprising:

fluidically sealing the interface between the other end of the tubular liner and the wellbore casing.

10. A method for creating a downhole seal between a first tubular and a second tubular, the first and second tubulars each having a top end and a bottom end, comprising:

positioning the first tubular at a selected depth within the wellbore;

expanding the inner diameter of the top end of the first tubular;

running the second tubular into the wellbore; and

mating the bottom end of the second tubular into the top end of the first tubular, the bottom end of the second tubular being configured to sealingly land into the expanded inner diameter of the first tubular, thereby creating a fluid seal between the first and second tubulars.

11. The method for creating a downhole seal between a first tubular and a second tubular of claim 10, wherein the outer surface of the bottom end of the second tubular has a sealing element for facilitating the fluid seal between the first and second tubulars.

12. The method for creating a downhole seal between a first tubular and a second tubular of claim 11, wherein expanding the inner diameter of the top end of the first tubular is accomplished by applying a radial force to the inner surface of the first tubular so as to radially expand the inner

surface of the first tubular from a first diameter to a second diameter along a selected length at the top end of the first tubular, thereby forming a polished bore receptacle.

13. The method for creating a downhole seal between a first tubular and a second tubular of claim 12, wherein the radial force applied to the first tubular is applied by forcing a swaged cone a distance into the top end of the first tubular, the swaged cone having a diameter at its lower end that is smaller than the diameter at the widest point of the swaged cone and that is also smaller than the inner diameter of the first tubular.

14. The method for creating a downhole seal between a first tubular and a second tubular of claim 13, wherein  
the first tubular defines a string of casing;  
the wellbore further comprises at least one upper string of casing set in the wellbore immediately above the first tubular, the upper string of casing also having a top end and a bottom end;  
the top end of the first tubular is positioned in the wellbore such that the top end of the first tubular overlaps with the bottom end of the upper string of casing; and  
the second tubular defines a string of production tubing.

15. The method for creating a downhole seal between a first tubular and a second tubular of claim 14, further comprising the step of removing the swaged cone from the wellbore after the polished bore receptacle has been created.

16. A method for creating a polished bore receptacle at the upper end of a string of casing comprising:  
positioning the string of casing at a selected depth within a wellbore;  
running a swaged cone into the wellbore at the lower end of a working string, the swaged cone having a diameter at its lower end that is smaller than the diameter at the widest point of the swaged cone and that is also smaller than the inner diameter of the string of casing;  
forcing the swaged cone downward into the upper end of the string of casing along a desired distance, thereby expanding the inner surface of the upper end of the string of casing from a first diameter to a second diameter such that the second diameter is dimensioned to sealingly receive a lower end of a string of production tubing;  
removing the swaged cone from the wellbore;  
running the string of production tubing into the wellbore after the cone has been removed; and  
landing the bottom end of the string of production tubing into the expanded top end of the string of casing, the bottom end of the string of production tubing being configured to sealingly land into the



expanded inner diameter of the string of casing, thereby creating a fluid seal between the string of casing and the string of production tubing.

17. The method for creating a polished bore receptacle at the upper end of a string of casing of claim 16, wherein the lower end of the string of production tubing has a sealing element around an outer surface for facilitating the fluid seal between the expanded inner surface of the upper end of the string of casing, and the lower end of the string of production tubing.

18. The method for creating a polished bore receptacle at the upper end of a string of casing of claim 17, wherein the sealing element comprises a plurality of elastomeric rings circumferentially disposed about the outer surface of the lower end of the production tubing.